

D-70, D-140, D-210, and D-280 Series Electric Non-Spring Return Actuators

(8, 16, 24, and 32 N·m)

Installation

IMPORTANT: The D- Series actuators are intended to control equipment under normal operating conditions. Where failure or malfunction of a D- Series actuator could lead to an abnormal operating condition that could cause personal injury or damage to the equipment or other property, other devices (limit or safety controls) or systems (alarm or supervisory) intended to warn of, or protect against, failure or malfunction of the D- Series actuator must be incorporated into and maintained as part of the control system.

Mount D- Series actuators in any convenient orientation. Install the actuators on a 3/8 to 3/4 in. (9.5 to 19 mm) round shaft or a 3/8 to 5/8 in. (9.5 to 16 mm) square shaft, 2 in. (51 mm) or longer. If the shaft is less than 2 in. (51 mm) long, install an extension recommended by the damper or valve manufacturer.

To mount the actuator, proceed as follows:

1. Press and hold the gear release lever, and rotate the coupler to the 0 or 90° position. Release the gear release lever. (See Figure 1.)

Parts Included

All Models

- Delta D- Series actuator
- DDA-160 anti-rotation bracket
- two No. 12-24 x 1/2 in. self-tapping hex washer-head screws

D24-210 and D24-280

Include one DDA-105 pluggable 3-terminal block

D24-210-FB135 and D24-FB1K

Include two DDA-105 pluggable 3-terminal blocks

D24-210-A and D24-280-A

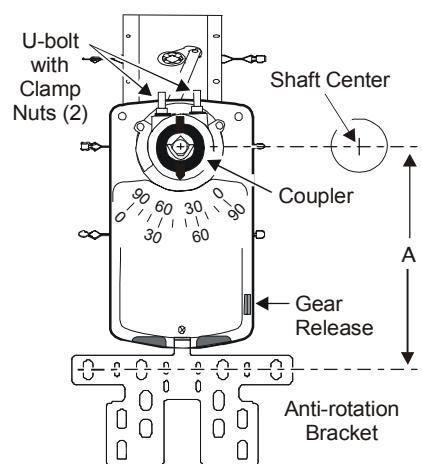
Include three DDA-105 pluggable 3-terminal blocks

Special Tools Needed

- torque wrench with 10 mm socket
- digital voltmeter or DDA-200 commissioning tool (for the models with zero and span potentiometers)

Mounting

IMPORTANT: The actuator is intended for indoor mounting only, with no direct exposure to water beyond NEMA 2 conditions. Use an appropriate shield or enclosure where the environment exceeds NEMA 2 specifications.



Note: A is the distance from the center of the holes in the anti-rotation bracket to the center of the shaft. (See Table 1 for dimensions.)

Figure 1: Mounting Positions

Table 1: Shaft Sizes and Distances from the Anti-Rotation Bracket to Shaft Center

Shaft Diameter	5/8 in.	1/2 in.	3/8 in.
A Dimensions (See Figure 1.)	6-1/8 in.	6-3/16 in.	6-1/4 in.
	155 mm	157 mm	159 mm

2. Bend or cut the anti-rotation bracket to fit the damper frame or duct as shown in Figure 2.

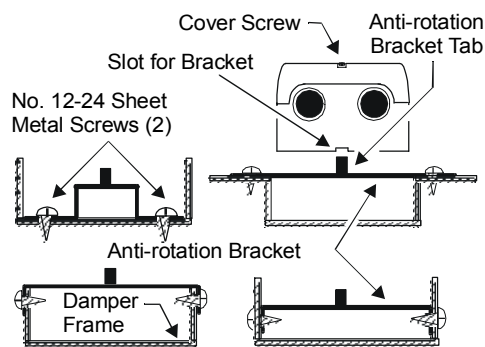


Figure 2: Anti-Rotation Bracket Positions

3. Close the damper.
4. Insert the anti-rotation bracket tab into the slot at the bottom of the actuator (shown in Figure 2), and slide the actuator onto the shaft.

IMPORTANT: The tab on the anti-rotation bracket must fit midpoint in the actuator slot to prevent actuator binding and premature wear.

5. Use the anti-rotation bracket as a guide, and drill the holes in the damper frame or duct for the bracket (based on the measurements obtained in Figure 1 and Table 1).
6. Attach the anti-rotation bracket to the damper frame or duct with the two self-tapping screws provided, using a 1/4 in. (7 mm) flat-blade screwdriver or 5/16 in. (8 mm) nut driver.

IMPORTANT: Do not overtighten the mounting screws to avoid stripping the threads.

7. Slide the actuator onto the damper shaft, positioning the tab on the anti-rotation bracket midway into the slot at the bottom of the actuator.

IMPORTANT: For Variable Air Volume applications that use a DM24-70 Series actuator, secure the coupler to the shaft with the damper in the fully open position to avoid damaging the open position end-stop.

8. Hold the actuator in place, and evenly hand tighten each clamp nut onto the U-bolt. Secure the U-bolt to the damper shaft by tightening clamp nuts to a torque of 100 to 125 lb·in (11 to 14 N·m).

9. Press and hold the gear release. Rotate the coupler fully closed to fully open to verify that the damper and actuator rotate freely throughout the range.

Rotation Range

The actuator comes factory set for 0 to 90° rotation. To change the rotation range to less than 90°, use the top scale on the actuator cover, refer to Figure 3, and proceed as follows:

1. Press and hold the gear release, and rotate the actuator coupler Counterclockwise (CCW) to the 0° position. Release the gear release.

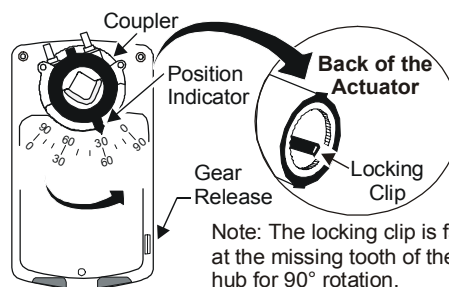


Figure 3: Actuator Components

2. Turn the actuator over, use a flat-blade screwdriver to release the locking clip, and remove the coupler from the front of the actuator.
3. Reinsert the coupler into the front of the actuator, and align the position indicator with the starting point of the desired rotation range.

IMPORTANT: Advancing the coupler 90° from the factory setting prevents the actuator from driving in either the Clockwise (CW) or CCW direction.

4. Push the coupler into the actuator until the locking clip snaps over the hub, securing it in place.

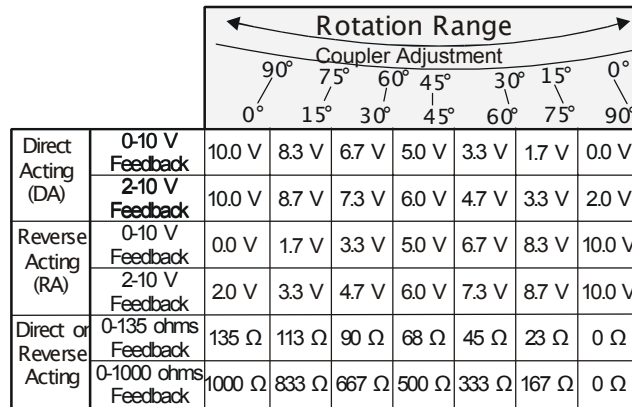
Note: To change the rotation range on:

- **-A models with auxiliary switches**, one or both of the switches may need adjustment. See the *Auxiliary Switches (-A Models)* section.
- **-Z and -Z-A models with zero and span potentiometers**, adjust both potentiometers. See the *Potentiometers (Proportional Models)* section.

Feedback Signal

For resistance-type feedback, the signal varies with a change to the rotation range. Resistance feedback reduction corresponds to the reduced rotation range.

For analog-type feedback, a change to the rotation range changes the feedback signal and the operating range proportionally. (See Figure 4.)



Note: 0-10 V or 2-10 V is available on DM24 models.
0-135 ohms feedback is available on -FB135 models and
0-1000 ohms feedback on FB1K models.

Figure 4: Nominal Feedback Signal Relative to the Rotation Range

Wiring



CAUTION: Risk of Equipment Damage.
Disconnect all power supplies before making wiring connections or prior to performing maintenance. Check all wiring connections before applying power to the system. Short-circuited or improperly connected wires will result in permanent damage to the equipment.

IMPORTANT: Make all wiring connections in accordance with local, national, or regional regulations.

Refer to Figure 5 for the applicable D- Series actuator.

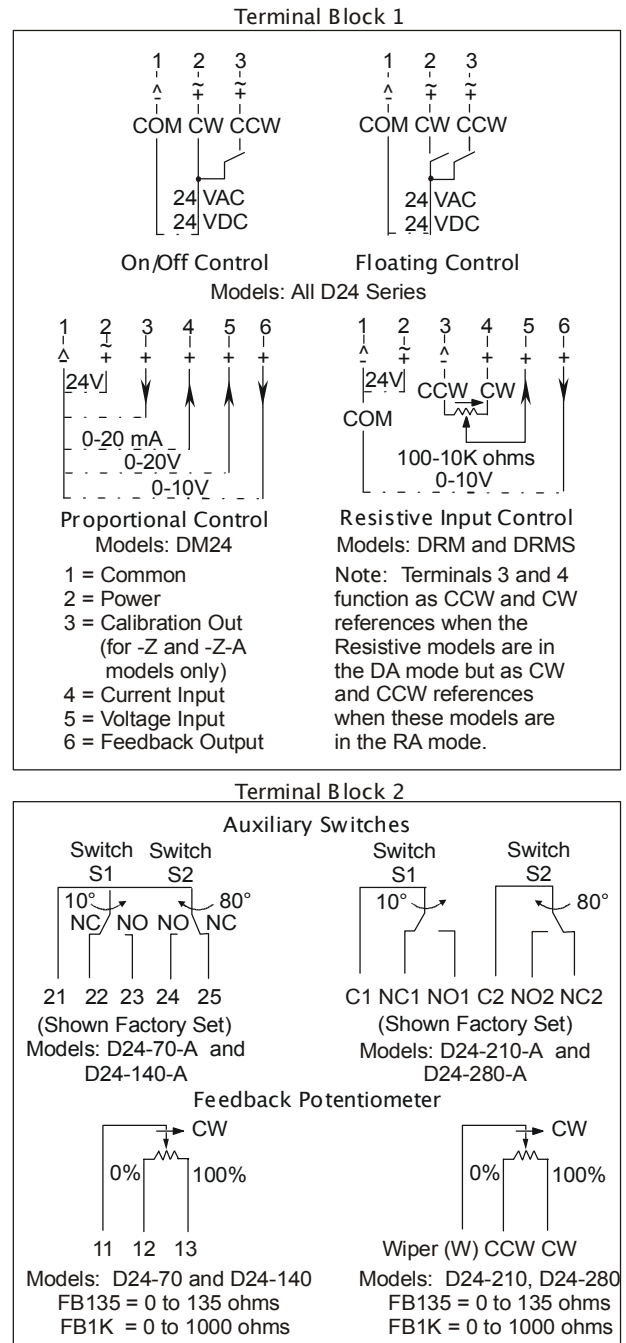


Figure 5: Wiring Diagrams for D- Series Models

Through the Conduit Openings

Depending on the D- Series model selected, use one or both conduit openings. The threaded actuator conduit openings accept 1/2 in. trade size conduit fittings. Refer to Figure 6 and proceed as follows:

1. Loosen the cover screw with a Phillips No. 1 screwdriver, and remove the actuator cover.

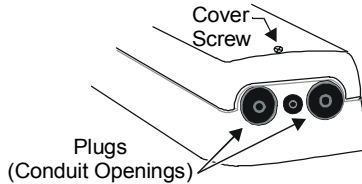


Figure 6: Location of the Conduit Openings

2. Push the plastic plug out of the conduit opening with fingertip.
3. Use the Phillips screwdriver to puncture a hole through the center of the plug, and reinsert the plug into the conduit opening.

Note: For applications requiring metal conduit, thread the conduit fitting into the conduit opening and hand tighten.

IMPORTANT: Use flexible metallic tubing or its equivalent with the fitting. Do not overtighten the conduit fitting into the actuator to avoid damaging the actuator threads.

4. Insert the cable wires through the plastic plug or conduit fitting, and connect to the terminal block using the applicable wiring diagrams in Figure 5.
5. Perform the procedures appropriate to the specific application, as described in the *Tandem Operation* and *Setup and Adjustments* sections.
6. Reattach the cover and tighten the cover screw.

Tandem Operation

The tandem configuration provides twice the torque of a single actuator as follows: 280 lb·in (32 N·m) for two DM24-140s, 420 lb·in (48 N·m) for two DM24-210s, or 560 lb·in (64 N·m) for two DM24-280s. The actuators operate in exact synchronization, ensuring the load is split evenly between each unit.

Models with the same torque and control input may be mounted in tandem. For example:

- one DM24-140 and one DM24-140-Z-A
- one DM24-210 and one DM24-210-Z
- one DM24-280 and one DM24-280-A

Note: Do not use **D24-70** or **-140** or **DM24-70** Series models in tandem.

The Master/Slave Jumper is factory set in the master position. Determine the method for mounting the two actuators in tandem: front-to-back (Figure 7 shows the front view) or back-to-back and proceed as follows:

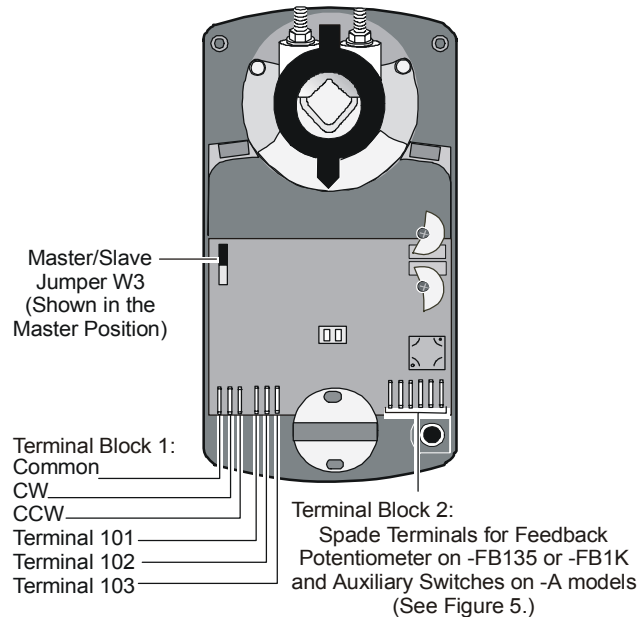


Figure 7: Settings on On/Off and Floating (D24-210 and D24-280) Models

1. Designate one actuator as the master, and move the Master/Slave Jumper on the other actuator to the slave position.
2. Connect Terminal 101, Terminal 102, and Terminal 103 from the master actuator to the corresponding terminals on the slave actuator. (See Figure 7 for D24 models and Figure 8 for DM24 models.)
 - a. When mounting two actuators front-to-back on the same shaft, connect:
 - Terminal 101 from the master actuator to Terminal 101 on the slave actuator

- Terminal 102 from the master actuator to Terminal 102 on the slave actuator
 - Terminal 103 from the master actuator to Terminal 103 on the slave actuator
- b. When mounting two actuators back-to-back on the same shaft, connect:
- Terminal 101 from the master actuator to Terminal 102 on the slave actuator
 - Terminal 102 from the master actuator to Terminal 101 on the slave actuator
 - Terminal 103 from the master actuator to Terminal 103 on the slave actuator

Note: The total wire length for these connections may be up to 30 ft (9 m).

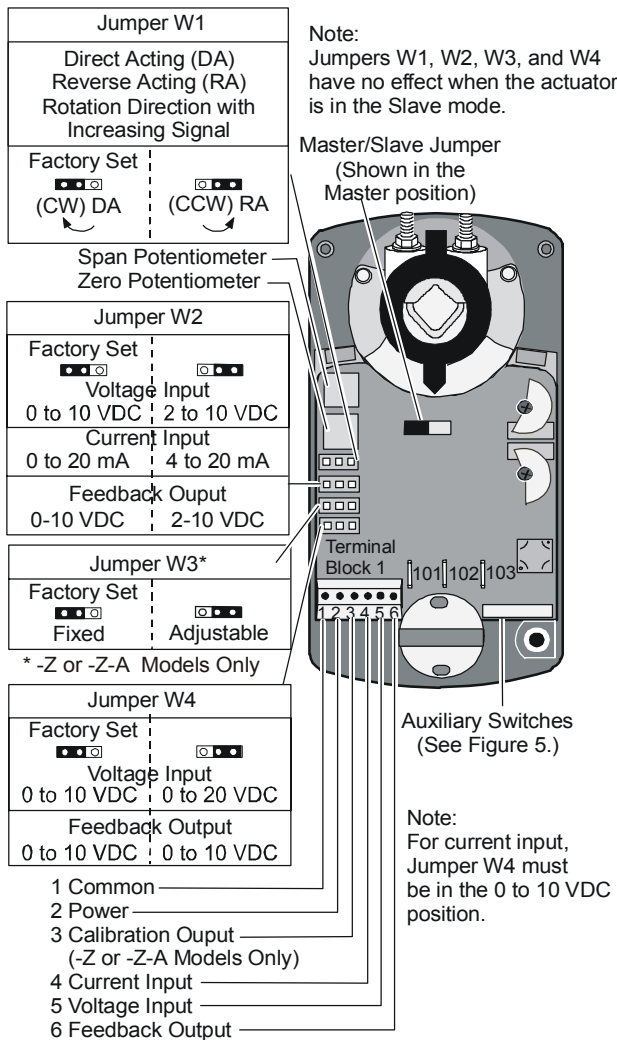


Figure 8: Settings on Proportional (DM24) Models

3. Connect the input control signal:

- For **D24-210 and -280 models**, connect the input control signal to the common, CW, and CCW terminals on both the master and slave actuators. (See Figure 7).
- For **DM24-140, -210, and -280 Models**, connect the control signal to the master actuator and connect 24 VAC/VDC power to both the master and slave actuators.

IMPORTANT: For proper tandem operation, do not connect the control input to the slave unit.

Note: Set the master actuator jumpers on the **DM24-140, -210, and -280 models** according to the action and signal range desired before proceeding. (Refer to Figure 8 and the *Setup and Adjustments, Calibration* section.)

4. Make sure of the following if the actuators configured for tandem operation stall or do not drive:

- Both actuators have the same torque and control input.
- One actuator is set as the master and the other as the slave.
- The control signal is connected to the master actuator only.
- Terminal 101, Terminal 102, and Terminal 103 are connected properly, as described in Step 2.

Setup and Adjustments

Calibration

Calibrate only the actuator designated as the master when using a combination of **two D24-210 or -280** or **two DM24-140, -210, or -280 models in tandem**.

Direction of Action

In the DA mode, a minimum control signal drives the actuator to the full CCW position, and a maximum control signal drives it fully CW. In the RA mode, a minimum control signal drives the actuator to the full CW position, and a maximum control signal drives it fully CCW. To set an actuator for RA, proceed to the section for the appropriate model.

IMPORTANT: Adjust the rotation range before changing the direction of action.

On/Off and Floating (D24) Models

To set one of these models for RA operation, reverse the control wiring connections at Terminal 2 and Terminal 3. (See Terminal Block 1 in Figure 5.)

Proportional (DM24) and Resistive (DRM24) Models

To set one of these models for RA operation, proceed as follows:

1. Press and hold the gear release, rotate the actuator coupler until it is in the full CW position, and release the gear release.
2. Move Jumper W1 from the factory-set DA position to the RA position. (See Figure 8.)
3. Apply power and then a control signal to the actuator to verify that the actuator is fully CW at minimum control input, and fully CCW at maximum control input.

Note: The **-Z** and **-Z-A** models may require potentiometer settings. Proceed to the *Potentiometers (Proportional Models)* section.

Jumpers

On/Off and Floating (D24-210 and -280) models come factory-set with the Master/Slave Jumper in the master position, and have no additional jumpers.

Proportional (DM24-140, -210, and -280) models come factory set with the Master/Slave Jumper in the master position. **Proportional (DM24) and resistive (DRM24) models** come factory set with Jumper W1 in the DA position. **Proportional models** have additional jumpers factory set as follows: Jumper W2 in the 0 to 10 VDC or 0 to 20 mA position, and Jumper W4 in the 0 to 10 VDC position. (See Figure 8.)

Note: The **-Z** and **-Z-A** models have an additional jumper, Jumper W3, factory set in the fixed position. On/Off and Floating models do not have jumpers.

Potentiometers (Proportional Models)

IMPORTANT: Adjust both zero and span potentiometers for full actuator travel and complete calibration.

The **-Z** and **-Z-A** models have zero and span potentiometers that do not require adjustment when Jumper W3 is factory set in the fixed position. When Jumper W3 is in the Adjustable (ADJ) position, proceed as follows:

Using either Terminal 3 and Terminal 5 or Terminal 3 and Terminal 4, a control signal, and a voltmeter, the zero and span potentiometers may be adjusted

without waiting for the actuator to drive to the final position.

Adjusting the Zero and Span

To adjust the zero and span potentiometers on the **-Z** and **-Z-A** models:

1. Verify that Jumper W2 is in the 0 to 10 VDC position, and provide 24 VAC or 24 VDC power to Terminal 1 (Common) and Terminal 2.
2. Connect the Common from the controller to Terminal 1, and either a voltage signal to Terminal 5 or a current signal to Terminal 4.
3. Connect Terminal 1 and Terminal 3 to a voltmeter to monitor the calibration output.
4. Use a 1/8 in. (3 mm) flat-blade screwdriver to turn the zero potentiometer fully CW and the span potentiometer fully CCW.
5. Apply the minimum (zero point) control signal required for positioning the actuator at the minimum position.
6. Monitor DC calibration output. To adjust the zero potentiometer, turn it CCW until the voltmeter displays 0 volts or slightly less.
7. Adjust the control signal to the maximum voltage desired to cause full rotation.
8. Monitor the calibration output at Terminal 1 and Terminal 3. Adjust the span potentiometer CW to increase the calibration output to 10 V.
9. Verify that the actuator is properly calibrated by adjusting the control signal to the minimum and maximum levels.

Example for a zero of 3 VDC and a span of 5 VDC:

- Apply a 3-volt control signal to the actuator, and turn the zero potentiometer CCW until the calibration output at Terminal 3 is 0 volts.
- Apply maximum voltage. (In this case, it is 8 VDC, which results in a span of 5 volts.)
- Monitor calibration output at Terminal 3, and adjust the span potentiometer CW to 10 volts.

Auxiliary Switches (-A Models)

The **-A** models have two built-in auxiliary switches that allow setting at any angle between 0 and 90° (factory set for 10 and 80°, nominal). Refer to the *Technical Specifications* section for auxiliary switch ratings.

The following procedures serve as examples to change the position of the auxiliary switch angles:

Switch S1

To change the angle of Switch S1 to 20°, refer to Figure 9 and proceed as follows:

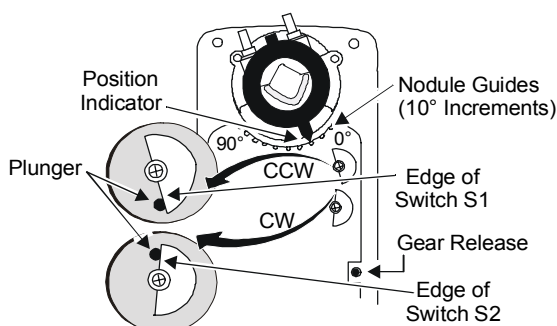


Figure 9: Switch Angle Settings

1. Depress the gear release, and using the 0 to 90° nodule guides, rotate the coupler until the position indicator is at 20°.
2. Loosen the screw on Switch S1 with a Phillips No. 1 screwdriver.
3. Rotate Switch S1 CCW, and align the edge of the switch with the plunger until the plunger rises.

Note: The normally closed contact closes, and the normally open contact opens. (See Auxiliary Switches in Terminal Block 2 of Figure 5.)

4. Retighten the Phillips-head screw on Switch S1, while holding it in the designated position.

Switch S2

To change the angle of Switch S2 to 70°, (see Figure 9) proceed as follows:

1. Depress the gear release, and using the 0 to 90° nodule guides, rotate the coupler until the position indicator is at 70°.
2. Loosen the screw on Switch S2 with a Phillips No. 1 screwdriver.
3. Rotate Switch S2 CW, and align the edge of the switch with the plunger until the plunger rises.

Note: The normally closed contact opens, and the normally open contact closes. (See Auxiliary Switches in Terminal Block 2 of Figure 5.)

4. Retighten the Phillips-head screw on Switch S2, while holding it in the designated position.
5. Depress the gear release, and rotate the coupler until the position indicator is back to 0°.

Repairs and Replacement

Do not field repair the D- Series actuators. To order a replacement or an accessory, refer to the Delta *D-70, D-140, D-210, and D-280 Series Electric Non-Spring Return Actuators Product Bulletin (LIT-10000033)*.

Technical Specifications

Product	D-70, D-140, D-210, and D-280 Series Electric Non-Spring Return Actuators		
Power Requirements (Class 2)	D24-70 and D24-140 Series:		
	20 to 30 VAC at 50/60 Hz or 24 VDC $\pm 10\%$; 6.5 VA supply minimum		
Input Signal	All Other Models:		
	20 to 30 VAC at 50/60 Hz or 24 VDC $\pm 10\%$; 7.5 VA supply minimum		
Input Signal Adjustments	D24:		
	24 VAC at 50/60 Hz or 24 VDC		
Input Signal Adjustments	DM24:		
	0 (2) to 10 VDC, 0 (4) to 20 VDC, or 0 (4) to 20 mA		
Input Signal Adjustments	DRM24:		
	Potentiometer value is 100 ohms minimum to 10,000 ohms maximum.		
Input Signal Adjustments	D24:		
	Factory Setting:		
Input Signal Adjustments	Terminals 1 and 2, CW rotation;		
	Terminals 1 and 3, CCW rotation		
Input Signal Adjustments	DM24 (Voltage Input or Current Input):		
	Factory Setting:		
Input Signal Adjustments	0 to 10 VDC, 0 to 20 mA, CW rotation with		
	signal increase		
Input Signal Adjustments	Jumper Selectable:		
	0 (2) to 10 VDC, 0 (4) to 20 VDC, or 0 (4) to 20 mA		
Input Signal Adjustments	-Z, -Z-A:		
	Adjustable Zero, 0 to 6 VDC, 0 to 12 VDC, or 0 to 12 mA		
Input Signal Adjustments	Adjustable Span, 2 to 10 VDC, 4 to 20 VDC, or 4 to 20 mA		
	Action is jumper selectable Direct (CW) or Reverse (CCW) with		
Input Signal Adjustments	signal increase.		
	DM24, DRM24:		

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Technical Specifications (Cont.)

Input Impedance	DM24:	Voltage Input	205,000 ohms for 0 (2) to 10 V and 410,000 ohms for 0 (4) to 20 V
	DRM24:	Current Input	500 ohms 1.8 megohms
Feedback Signal	-FB135:	135 ohm feedback potentiometer	
	-FB1K:	1,000 ohm feedback potentiometer	
	DM24:	0 to 10 VDC or 2 to 10 VDC for 90° (10 VDC at 1 mA), corresponds to input signal span selection.	
	DRM24:	0 to 10 VDC for 90° (10 VDC at 1 mA)	
Auxiliary Switch Rating	-A:	Two Single-Pole, Double Throw (SPDT) switches rated at 24 VAC 1.5 A inductive, 3.0 A resistive, 35 VA maximum per switch, Class 2	
Mechanical Output (Running Torque)	D-70 Series:	70 lb·in (8 N·m) for one unit; not intended for tandem use	
	D-140 Series:	140 lb·in (16 N·m) for one unit	
	DM-140 (in tandem):	280 lb·in (32 N·m) for two units	
	D-210 Series:	210 lb·in (24 N·m) for one unit	
	D or DM-210 (in tandem):	420 lb·in (48 N·m) for two units	
	D-280 Series:	280 lb·in (32 N·m) for one unit	
	D or DM-280 (in tandem):	560 lb·in (64 N·m) for two in units	
Audible Noise Rating	45 dBA at 1 m		
Rotation Range	0 to 90° in 5-degree increments, mechanically limited to 93°		
Rotation Time (Each Series)	D-70 Series:	30 s at 50% rated load 25 to 50 s for 0 to 70 lb·in (0 to 8 N·m)	
	D-140 Series:	80 s at 50% rated load, 70 to 115 s for 0 to 140 lb·in (0 to 16 N·m)	
	D-210 Series:	130 s at 50% rated load 115 to 175 s for 0 to 210 lb·in (0 to 24 N·m)	
	D-280 Series:	140 s at 50% rated load 115 to 205 s for 0 to 280 lb·in (0 to 32 N·m)	
Electrical Connection	D-210 Series and D-280 Series:	1/4 in. spade terminals with pluggable terminal blocks	
	All Other Models:	Screw terminals for 22 to 14 AWG; a maximum of two 18, 20, or 22 AWG per terminal	
Mechanical Connection	3/8 to 3/4 in. (10 to 20 mm) diameter round shaft or 3/8 to 5/8 in. (10 to 16 mm) square shaft		
Enclosure	NEMA 2, IP42		
Ambient Conditions	Operating:	-4 to 122°F (-20 to 50°C); 0 to 95% RH, noncondensing	
	Storage:	-40 to 186°F (-40 to 86°C); 0 to 95% RH, noncondensing	
Dimensions (H x W x D)	7.09 x 3.94 x 2.54 in. (180 x 100 x 64.5 mm)		
Shipping Weight	2.9 lb (1.3 kg)		
Agency Compliance	UL Listed, File E190867, CCN XAPX CSA Certified, File LR703029, Class 3221 02 CE Mark, EMC Directive 89/336/EEC Plenum rated in accordance with CSA C22.2 No. 236/UL 1995, Heating and Cooling Equipment.		

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult Delta Control Products. Delta Control Products, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.